Lake Ontario
Lower Aquatic Foodweb Assessment

Understanding Change in a Post-Zebra Mussel Foodweb

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Why the Interest in the Lower Aquatic Foodweb?

The introduction of exotic zooplankton and mussels has dramatically altered Lake Ontario's aquatic foodweb over the last decade. The near disappearance of Lake Ontario's keystone benthic organism, the amphipod Diporeia, in waters less than 100 m deep threatens the viability of fisheries as well as efforts to restore naturally reproducing populations of lake trout. It is suspected that dreissenid mussels (zebra & quagga) have been able to out-compete Diporeia for nutrients. There are also concerns that recently introduced exotic zooplankton, such as Cercopagis have the potential to alter native zooplankton communities.

In 2003 U.S. and Canadian fishery and water quality experts coordinated monitoring activities and pooled resources to conduct the Lake Ontario Lower Aquatic Foodweb Assessment (LOLA) to determine the extent to which invasive species have altered the lower aquatic foodweb over the last decade. This project was developed to meet the information needs of the U.S.- Canada Lake Ontario Lakewide Management Plan and the Great Lakes Fishery Commission's Lake Ontario Committee.

Project Partners

- EPA Region 2
- EPA GLNPO
- EPA MED/ORD NHEERL
- NOAA GLERL
- Cornell University
- NYS Dept. of Environmental Conservation
- Environment Canada
- Ontario Ministry of the Environment.
- Ontario Ministry of Natural Resources
- Dept. of Fisheries & Oceans
- University of Toronto

Background

Lake Ontario is the last in the Great Lakes chain. It supports a valuable commercial and recreational fishery and provides an excellent source of drinking water to surrounding communities.

Zebra & Quagga Mussels

Dreissena polymorpha & bugensis

Dreissenid mussels arrived in Lake Ontario in 1989 and quickly spread throughout the lake. These mussels are voracious filter feeders and appear to be able to out-compete native species for nutrients. The quagga mussel, a close cousin and look-a-like of the zebra mussel, is now the dominant mussel in the lake.

Cercopagis

First observed in Lake Ontario in 1998, this zooplankton invader is native to the Ponto-Caspian region of Eurasia. It feeds on smaller zooplankton. It was most likely transported to the Great Lakes via ship ballast water. Little is known about the impact of Cercopagis on the Lake Ontario foodweb

Diporeia

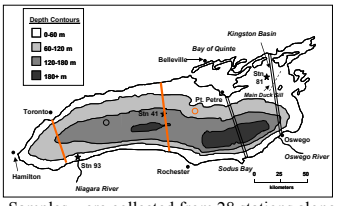
This amphipod was once Lake Ontario's dominant benthic species comprising >80% of the total benthic biomass and an important source of food for fish. Although a clear cause and effect relationship has yet to be established, Diporeia disappeared from much of Lake Ontario once dreissenid mussels became established in the lake.

Coordinated U.S. – Canadian Sampling Approach

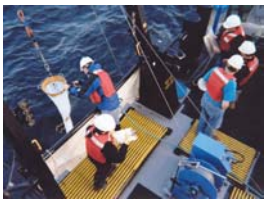
This sampling approach was modeled after lower aquatic foodweb assessments conducted by the Dept. of Fisheries & Oceans Canada (DFO) in the 1980s and 1990s. These pre-dreissenid mussel assessments provide a historical point of comparison for current conditions. Samples were collected with the same methods as the earlier DFO surveys. U.S. and Canadian vessels and sampling teams were coordinated to provide temporal and geographic coverage of nearshore and offshore areas for:

- Phosphorus, chlorophyll-a, silica;
- Phytoplankton, rotifers, microbial loop;
- Benthos, zooplankton & mysids (freshwater shrimp).

Interpretation of 2003 lower aquatic food web data will provide U.S. & Canadian fishery managers with an improved understanding of Lake Ontario's ability to support its commercial and recreational fisheries. It is hoped that the closer working relationships that have developed between U.S. and Canadian monitoring programs as part of this effort will lead to the development of a long term binational monitoring approach to track the status of the lower aquatic foodweb.



Samples were collected from 28 stations along four transects and two long term monitoring stations during Spring, Summer and Fall



Sampling activity on the deck of the Lake Guardian.

Strengthening EPA Partnerships

Data interpretation is underway as part of a Regional Applied Research Effort (RARE) coordinated by EPA Region 2 and EPA MED/ORD Duluth. The project will synthesize all available U.S. and Canadian data in determining the current state of the lower foodweb. Another component of this project will utilize ORD's expertise in remote sensing techniques, such as optical plankton counters, to improve on the current approaches used by EPA Region 2 and its partners in monitoring the status of Lake Ontario zooplankton communities.

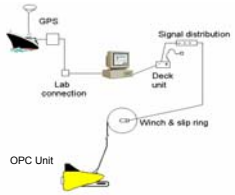
Lake Guardian
180 ft / 54 m
U.S. EPA GLNPO

Limnos
148 ft /45 m
Canadian Coast Guard

Lake Explorer
82 ft / 25 m
U.S. EPA MED/ORD

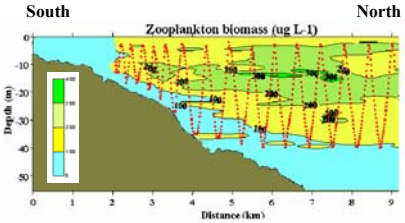
Developing New Biological Monitoring Tools

The development of a long term lower foodweb monitoring approach could be enhanced by combining traditional vertical net tow zooplankton sampling techniques with new optical plankton counter (OPC) remote sensing technology. Typically the number of vertical net tows that can be collected is limited due to the expense of sample analyses and ship time limitations. As a result regional patterns of zooplankton distribution may go unrecognized.



OPCs use a light beam to count and measure zooplankton that pass through it as it is towed through the water column. Data transmitted to a shipboard computer is processed to develop cross-sectional displays of zooplankton biomass and size spectra analyses. OPC surveys were performed in the Spring and Summer along two of the 2003 Lake Ontario cross-lake transects together with traditional vertical zooplankton net tows. The net tow and OPC results data will be evaluated to determine if these methods can be combined to provide more comprehensive regional scale assessments of zooplankton community status.

OPC unit attached to tow sled and ready for deployment. Temperature, conductivity and other monitoring instruments can also be attached to provide additional information.



Eastern Transect 12 June 2003

Preliminary OPC data showing a cross-sectional view of zooplankton biomass courtesy of Peder Yurista, EPA MED/ORD, Duluth. The trail of red dots indicates the path of the OPC unit as it is towed up and down thru the water column ("Tow-Yos").

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